Map Class 1
Hanging Gardens
(H-HGSS)

Photo credit: NPS

H-HGSS Map Class Statistics

Type	Point
Frequency	6 total project points
	6 points in NABR
	0 points in environs
Area	Total project area = N/A
Average Size	N/A
Proportion	N/A
Accuracy	100% (mapped only where known from plot data.)

Ecological System

Colorado Plateau Hanging Garden (CES304.764)

Association

Aquilegia micrantha - *Calamagrostis scopulorum* Herbaceous Vegetation [CEGL002592]

Common species

Aquilegia micrantha	*Calamagrostis scopulorum*
Cirsium calcareum	*Zigadenus elegans*
Schizachyrium scoparium	*Zigadenus vaginatus*

Distribution/Ecology/Composition

The best examples of this association are restricted to alcoves formed in the massive Cedar Mesa Sandstone. Less-well-developed examples occupy seeping cracks in cliff faces. Groundwater moving through the sandstone becomes concentrated by lenses of impermeable shale within the sandstone. Where these lenses are exposed in canyon walls, water emerges with a steady, year-round flow. Over time, alcoves form as water dissolves the calcareous cement holding the sandstone together. Hanging gardens occur in every major canyon within NABR and in many of the tributary canyons.

The availability of water throughout the growing season supports a unique assemblage of plants within the alcove and in the saturated talus downslope known as a hanging garden. Many species are endemic to the Colorado Plateau and are not found outside of hanging gardens. Characteristic species at NABR include *Calamagrostis scopulorum* and *Aquilegia micrantha*; both are usually present and have significant cover. *Cirsium calcareum, Adiantum capillus-veneris, Zigadenus* spp., and *Epipactis gigantea* are other endemic species that are often present. Common plants growing around the margins of the garden may include *Amelanchier utahensis, Prunus virginiana, Quercus gambelii, Cercocarpus intricatus, Pinus edulis,* and *Juniperus* spp. Although vegetation is dense within the gardens (usually exceeding 100%), examples are usually long and narrow; they may extend for more than 100m along a horizontal crack, but may be no more than 1 or 2m wide in most places.

Interpretation

This type was not interpreted; because it occurs on near-vertical cliff faces or beneath cliff overhangs, most examples are invisible on the aerial imagery. Instead, this type is documented by point data derived from the plots database.

Aquilegia micrantha - Calamagrostis scopulorum Herbaceous Vegetation
Mancos Columbine - Ditch Reedgrass Herbaceous Vegetation

CODE	CEGL002592
PHYSIOGNOMIC CLASS	Herbaceous Vegetation (V)
PHYSIOGNOMIC SUBCLASS	Perennial forb vegetation (V.B.)
PHYSIOGNOMIC GROUP	Temperate or subpolar perennial forb vegetation (V.B.2.)
PHYSIOGNOMIC SUBGROUP	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
FORMATION	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
ALLIANCE	*AQUILEGIA MICRANTHA* SATURATED HANGING GARDEN HERBACEOUS ALLIANCE (A.2506) Mancos Columbine Saturated Hanging Garden Herbaceous Alliance

ECOLOGICAL SYSTEM(S): Colorado Plateau Hanging Garden (CES304.764)

USFWS WETLAND SYSTEM: Not applicable

CONCEPT SUMMARY
Globally
This association is confined to seeps emerging from sandstone cliffs in the Colorado Plateau and lower elevation canyons in adjacent southern Rocky Mountains where it may occur on metamorphic substrates. Elevations are below 2000 m. Aspect is not important in determining the distribution of this association. Instead, seeps will tend to occur on the side of the canyon where gravity and hydrology combine to force groundwater out. The unvegetated surface often has high cover of bare soil, sometimes coated with a white calcareous crust or bedrock. For the most part, soils are derived from dissolution of sandstone grains and fragments from adjacent slopes and ledges and are saturated year-round from water seeping between sedimentary rock layers. In the case of a stand in the Black Canyon of the Gunnison, a north-facing alcove with a seep and overhanging ledge is cut into Black Canyon schist and gneiss. Total vegetation cover ranges from 20 to 75% and is characterized by clumps of *Calamagrostis scopulorum* and *Aquilegia micrantha*. In drier gardens, *Schizachyrium scoparium* may be dominant. Other herbaceous species occurring frequently in this association include *Zigadenus vaginatus, Epipactis gigantea, Platanthera zothecina, Cirsium ownbeyi, Petrophyton caespitosum, Dodecatheon pulchellum, Clematis ligusticifolia, Solidago nana, Pellaea glabella, Zigadenus elegans,* and *Solidago velutina*. There is no developed shrub or tree layer, but most occurrences include scattered woody plants such as *Pinus edulis, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites, Cercocarpus intricatus, Glossopetalon spinescens* var. *meionandrum, Betula occidentalis, Brickellia* sp., *Ericameria* sp., *Symphoricarpos rotundifolius, Holodiscus dumosus,* and *Rhus trilobata.*

DISTRIBUTION
Natural Bridges National Monument
This association is scattered within the canyon system and was sampled on ledges and in alcoves in Armstrong and White canyons and at a site 200 m northwest of the Kachina Bridge Trailhead. Many examples of this association are inaccessible because of steep, dangerous cliffs above and below.

Globally
This association has been documented from the Colorado Plateau and Uinta Basin of western Colorado and eastern Utah. It may also occur at Zion National Park (Malanson 1980, 1982), although it was not documented there during a recent (2003) NPS vegetation mapping effort.

ENVIRONMENTAL DESCRIPTION
Natural Bridges National Monument
This herbaceous association was observed in alcoves and on ledges in canyons where seeps and springs are present. Occurrences documented in the monument are on gentle to moderately steep (2- to 37-degree) slopes between 1793 and 1841 m elevation. The unvegetated surface often has high cover of bare soil (sometimes coated with a white calcareous crust) or litter, with a low cover of mosses and lichens. The

substrate is always Cedar Mesa sandstone, and the seeps occur where thin lenses of clay intercept groundwater moving through the sandstone forcing it to the surface. Soils are poorly drained and range from sandy loam to silt loam. For the most part, soils are derived from dissolution of sandstone grains and fragments from adjacent sandstone slopes and ledges.

Globally
This hanging garden association occurs on ledges and in crevices and alcoves in near-vertical sandstone canyon walls in southeastern Utah and northwestern Colorado and in Black Canyon on the Gunnison metamorphic substrate in west-central Colorado. Elevations are below 2000 m. Sandy soils that accumulate in the cliff crevices or at the bases of canyon alcoves are saturated year-round from water seeping between sedimentary rock layers or in the case of Black Canyon, a north-facing alcove with a seep and overhanging ledge is cut into Black Canyon schist and gneiss. Aspect is not important in determining the distribution of this association. Instead, seeps will tend to occur on the side of the canyon where gravity and hydrology combine to force water out. The unvegetated surface often has high cover of bare soil, sometimes coated with a white calcareous crust or bedrock. For the most part, soils are derived from dissolution of sandstone grains and fragments from adjacent slopes and ledges.

VEGETATION DESCRIPTION

Natural Bridges National Monument
This association is confined to seeps emerging from sandstone cliffs. Total vegetation cover ranges from 25 to 75% and is characterized by *Calamagrostis scopulorum* and *Aquilegia micrantha* that range in cover from 3 to 40% each. In drier gardens, *Schizachyrium scoparium* may be dominant. Other herbaceous species occurring frequently in this association include *Zigadenus vaginatus, Juncus balticus, Platanthera zothecina* (= *Habenaria zothecina*), *Heterotheca villosa, Zigadenus elegans,* and *Solidago velutina* (= *Solidago sparsiflora*). There is no developed shrub or tree layer, but most occurrences include scattered *Pinus edulis, Amelanchier utahensis, Prunus virginiana,* and *Paxistima myrsinites*. Mosses provide the bulk of the nonvascular cover.

Globally
This association is confined to seeps emerging from sandstone cliffs in the Colorado Plateau. Total vegetation cover ranges from 20 to 75% and is characterized by clumps of *Calamagrostis scopulorum* and *Aquilegia micrantha*. In drier gardens, *Schizachyrium scoparium* may be dominant. Other herbaceous species occurring frequently in this association include *Zigadenus vaginatus, Epipactis gigantea, Platanthera zothecina, Cirsium ownbeyi, Petrophyton caespitosum, Dodecatheon pulchellum, Clematis ligusticifolia, Solidago nana, Pellaea glabella, Zigadenus elegans*, and *Solidago velutina*. There is no developed shrub or tree layer, but most occurrences include scattered woody plants such as *Pinus edulis, Amelanchier utahensis, Prunus virginiana, Paxistima myrsinites, Cercocarpus intricatus, Glossopetalon spinescens* var. *meionandrum, Betula occidentalis, Brickellia* sp., *Ericameria* sp., *Symphoricarpos rotundifolius, Holodiscus dumosus*, and *Rhus trilobata*.

MOST ABUNDANT SPECIES

Natural Bridges National Monument

Stratum	Species
Herb (field)	*Aquilegia micrantha, Cirsium calcareum, Zigadenus elegans, Zigadenus vaginatus*
Herb (field)	*Calamagrostis scopulorum, Dichanthelium acuminatum*

Global

Herb (field)	*Aquilegia micrantha*
Herb (field)	*Calamagrostis scopulorum*

OTHER NOTEWORTHY SPECIES

Natural Bridges National Monument

Zigadenus vaginatus

Globally
Carex curatorum, Cirsium ownbeyi, Epipactis gigantea, Platanthera zothecina, Zigadenus vaginatus

CONSERVATION STATUS RANK
Global Rank & Reasons: GNR (7-Apr-2005).

CLASSIFICATION COMMENTS
Natural Bridges National Monument
Data are not available.

Globally
This association is part of a complex of herbaceous communities collectively known as "hanging gardens." Few systematic studies of these communities have been completed (e.g., Welsh and Toft 1981, Welsh 1989, Fowler 1995), and even fewer quantitative data are available, partly because stands can be difficult or dangerous to access. The National Park Service is undertaking systematic surveys of vegetation, particularly spring and seep communities, throughout the Colorado Plateau (Evenden pers. comm. 2005). As more data become available, the various hanging garden associations should be revisited. John Spence, botanist at Glen Canyon National Recreation Area, is reported to be in the process of publishing a comprehensive study and classification of hanging gardens in the Colorado Plateau (J. Spence pers. comm. 2005).

CLASSIFICATION CONFIDENCE: 2 - Moderate

ELEMENT SOURCES
Natural Bridges National Monument Inventory Notes: *Mimulus eastwoodiae* does not occur in these hanging gardens. Dense moss cover is present in the most mesic stands. Seeps and springs emerge where lenses of shale (representing interdunal wetlands) have eroded to form alcoves. After several years of drought, few of these seeps have surface water (drips).
Natural Bridges National Monument Plots: The description is based on 2003 field data (4 plots: NABR.0006, NABR.0012, NABR.0111, NABR.0113, and 1 observation points: NABR.9003).
Local Description Authors: A. Buechling, mod. J. Von Loh and J. Coles
Global Description Authors: J. Coles, mod. K.A. Schulz

REFERENCES: Evenden pers. comm., Fowler 1995, Malanson 1980, Malanson 1982, Spence pers. comm., Welsh 1989, Welsh and Toft 1981, Western Ecology Working Group n.d.